Ross Sea Cloud Satellite Observations, IOP, COSP

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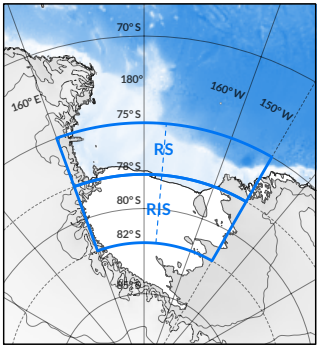
Ross Sea Cloud Satellite Observations

Objectives

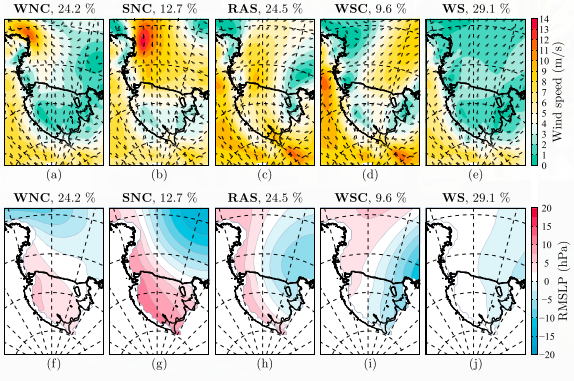
- Establish cloud climatology (*) over RS & RIS as seen by CloudSat/CALIPSO
- Follow-up on work by Coggins et al. (2016) on synoptic classification in the region
- Determine how cloud vertical distribution and properties vary with seasons and synoptic regimes



Ross Sea Cloud Satellite Observations

Coggins regimes

Weak Northern Cyclonic (WNC), Strong Northern Cyclonic (SNC), Ross Ice Shelf airstream (RAS), Weak Southern Cyclonic (WSC), Weak Synoptic (WS)



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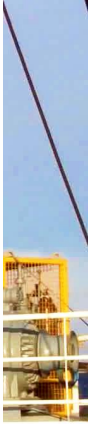
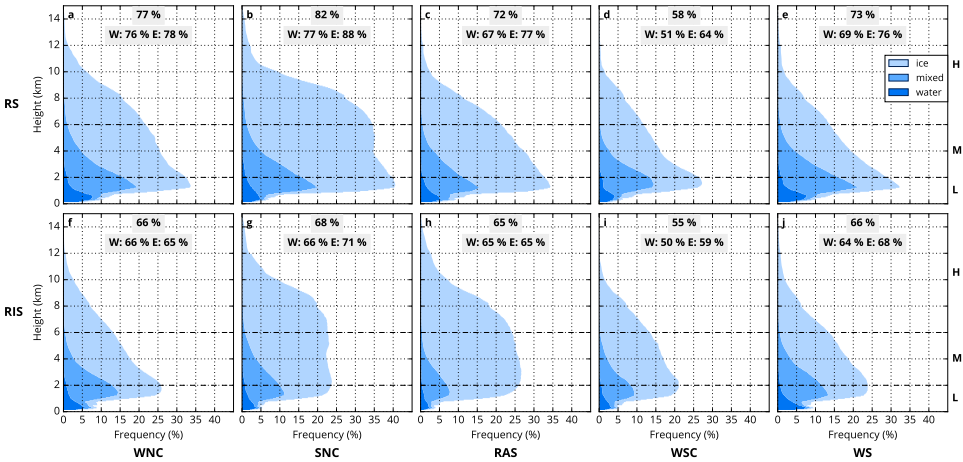


CloudSat-CALIPSO datasets

- Datasets:
  - 2B-GEOPROF-LIDAR P_R04 (2006–2011)
  - 2B-CLDCLASS-LIDAR P_R04 (2007–2011)
  - 2B-GEOPROF-LIDAR P_R05 (2006–2016)

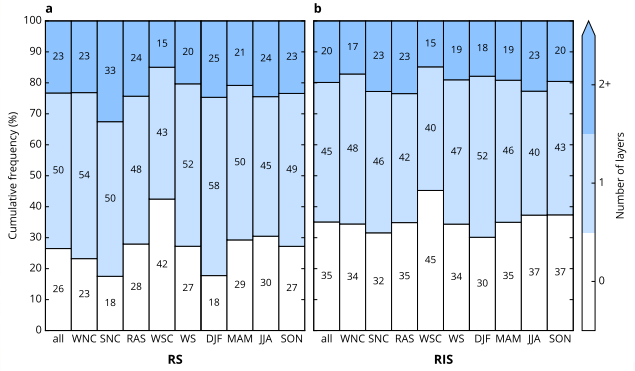
Ross Sea Cloud Satellite Observations

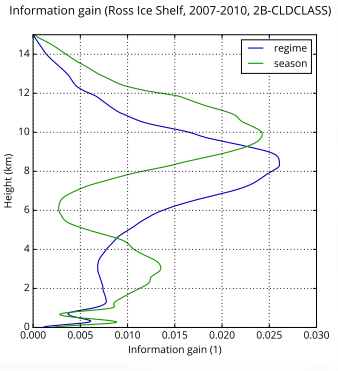
Ice shelf vs. sea



Ross Sea Cloud Satellite Observations

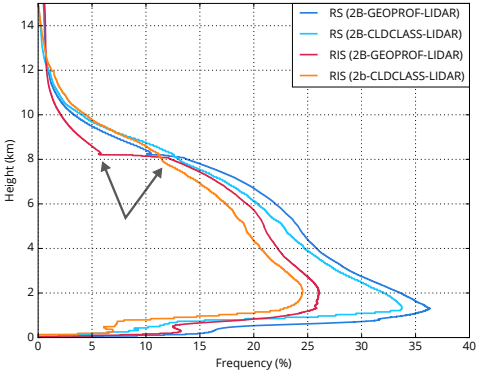
What is the role of seasons compared to weather regimes

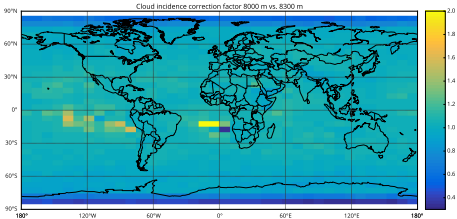




Ross Sea Cloud Satellite Observations

2B-GEOPROF-LIDAR P_R04 data issues



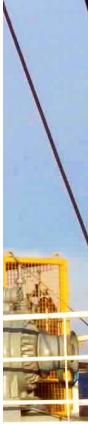


Ratio of cloud occurrence at 8.3 km rel. to 8 km

IOP

Objectives

- Create a comprehensive multi-year dataset of ground-based and in-situ observations of C&A in the SO
- Use them for NZESM evaluation and improve C&A parametrisation in the SO



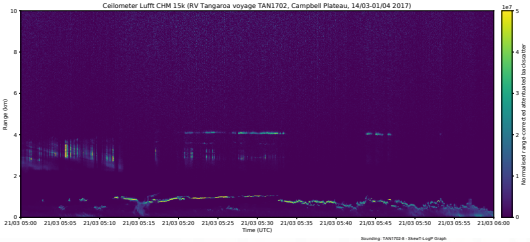
IOP

Instruments

- Ceilometer: Lufft CHM 15k, Vaisala CL51
- Radar: Metek MRR-2
- Radiosondes
- Sky-viewing camera
- AWS, pyranometers
- Aerosols (NIWA)

IOP

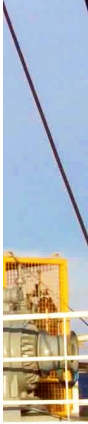
Complementing observations



IOP

Plans

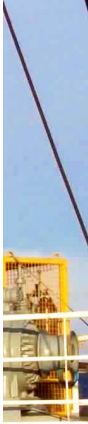
- Complete dataset:
  - All deployments
  - Well-documented
  - Standard data formats: NetCDF/HDF5 (CF)
  - Publicly available



COSP

Objectives

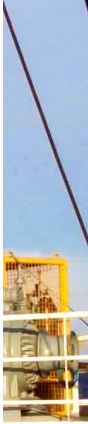
- Evaluation of NZESM using ground and in-situ observations of C&A in the Southern Ocean
- Use the COSP satellite simulator developed by CFMIP



COSP

Observations

- Ground-based and in-situ:
  - IOP
  - ARM
- Satellite:
  - Passive VIS & IR: ISCCP, MODIS, MISR, …
  - Radiative budget: CERES
  - Active: CloudSat, CALIPSO (possibly GLAS, CATS, EarthCARE)
  - Passive microwave (total column water): AMSR-E (Aqua), AMSR-2 (GCOM-W1), SSM/I (DMSP), MIS (NPOESS), TMI (TRMM)



COSP

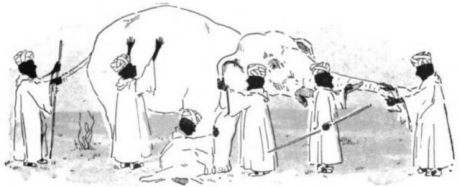
Simulators

- ACTSIM – lidar simulator
  - Input: water/ice mixing ratio (convective and stratiform), effective radius of cloud/ice particles
  - Output: backscatter
- QuickBeam – radar (CloudSat) simulator

COSP

Comparing the same thing

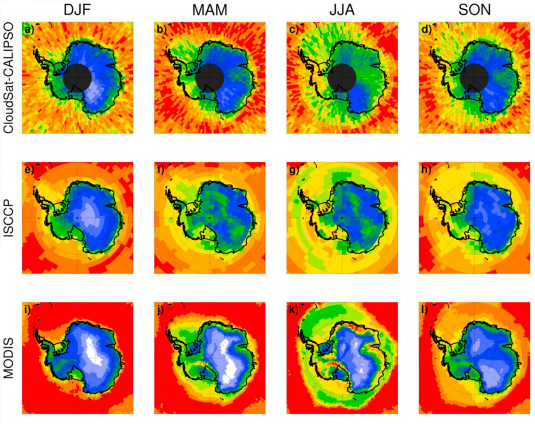
- Analogy: ‘Blind men and an elephant’



- Same physical quantity
- Resolution problem
- Spatial/temporal co-location
- Choice of False Alarm Ratio

COSP

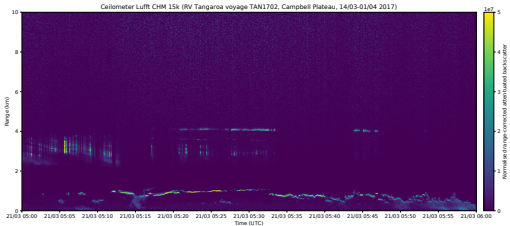
Mean seasonal cloud fraction (Bromwich et al., 2012)

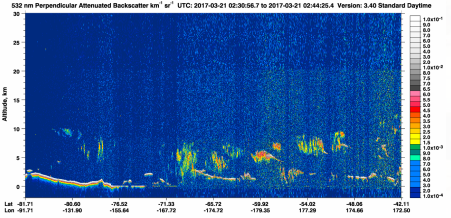


COSP

Ceilometer (IOP) vs. CALIPSO

- 2017-03-21 05:00 UTC, Campbell Plateau





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Model vs. observation vs. reality

Model

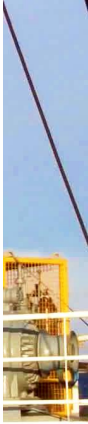
Cloud vertical distribution, fraction, phase, liquid/ice mixing ratio
Droplet size distribution/effective radius
Cloud subsampling (McICA) and overlap
Radiative transfer approximations
Cloud types: convective, stratus
Temperature profile and gas concentration

Observation

Cloud fraction, top, base, optical depth, geometric depth
Backscatter, radar reflectivity
Cloud types: Cu, St, Sc, DC, Ci
Temperature, humidity, pressure profile
Affected by error (type I, II, Gaussian, ...), bias, limited view, coverage, spatial/temporal res., spectral res.

Reality

Cloud droplet and ice crystal distribution
Aerosol distribution
Temperature profile and gas concentration



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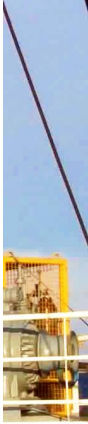
NZESM

- Nudged
- Unnudged
- COSP:
  - From model fields to pseudo-observations to derived properties



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The other way round

- Assimilation
- From observations to model fields (with proper uncertainty evaluation)
- Can we put multiple observations together?

COSP

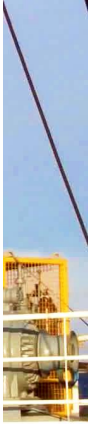
Upscaling

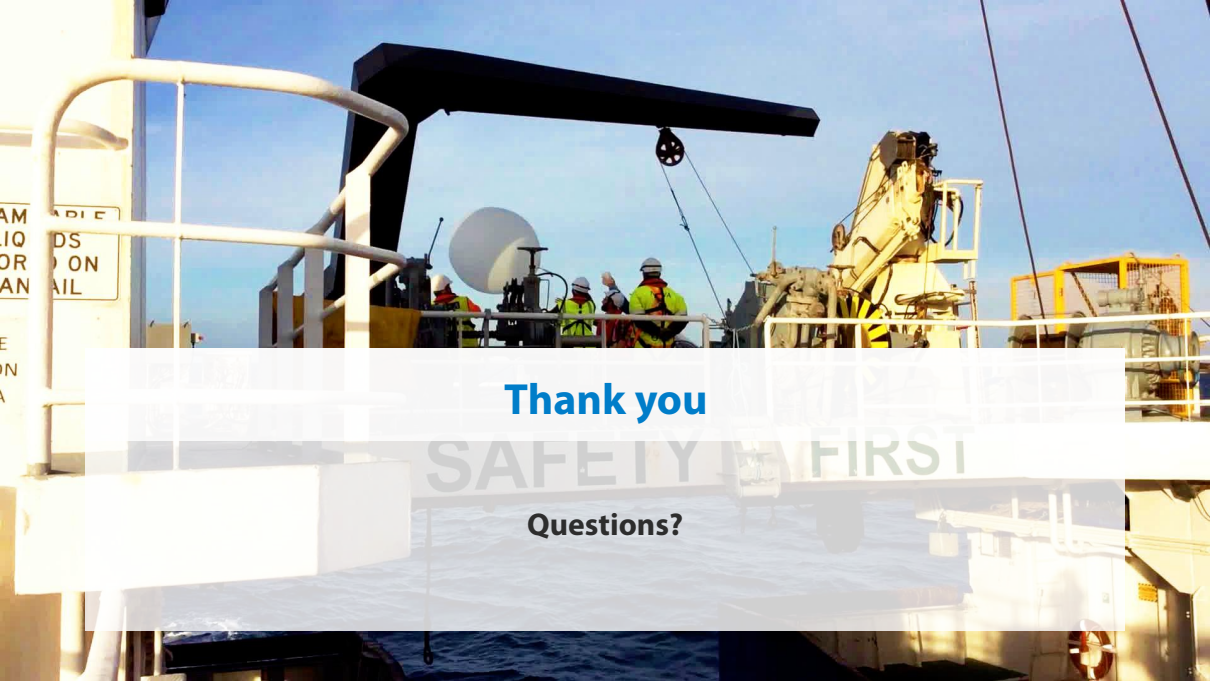
- Correlating ground-based observations with satellite observations
- Deriving pseudo ground-based observations based on satellite observations:
  - If we know what the satellite instruments sees, what would ground-based instruments be likely to see?

COSP

Challenges

- Subsampling (cloud resolving model)
- Nudging
- Small and irregular temporal and spatial coverage
- From backscatter to cloud layers





Thank you

Questions?